

SUSTAINABILITY OF ENERGY EFFICIENCY AND ENERGY SECURITY FOR AIRPORTS IN SOUTH AFRICA: GUIDELINES FOR TRANSITIONING EXISTING TERMINAL BUILDINGS TO GREEN BUILDING STATUS

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ABSTRACT

The execution of projects that achieve energy efficiency and energy conservation for existing infrastructure at a site reduces the site's carbon footprint. Adopting low carbon energy sources to power existing buildings further reduces the carbon footprint allowing carbon neutrality for the site to become achievable. Projects that adopt a low or no carbon emissions approach require investment, which, if operations at the respective sites do not preserve this approach, could negate the return on the investment and increase the carbon emissions of that site. Changes in personnel lead to inevitable loss in energy efficient working regimes thus requiring culture change programmes to restore energy conscious behaviour within daily operations. Working towards, then achieving and maintaining a green star rating for the existing buildings motivates and requires personnel to sustain reduced carbon emissions in all their work. The adoption of "green buildings" ensures compliance with environmental requirements including reduction in carbon emissions and energy consumption which serves to ensure that investments towards reduced carbon emissions realise their returns. This paper presents guidelines for transitioning existing airport terminal buildings towards the adoption of a green star rating as per the green star rating system of the Green Building Council of South Africa.

KEYWORDS: *Energy Efficiency, Energy Security, Green Buildings, Environmentally Sustainable Buildings, Environmental Responsibility, Resource Efficiency & Green Star Rated Airport Terminal Buildings*

Received: Aug 04, 2021; **Accepted:** Aug 24, 2021; **Published:** Oct 21, 2021; **Paper Id.:** IJMPERDDEC20218

INTRODUCTION

The challenge that any organisation faces, especially those exceeding ten people, is to ensure that the culture within a company does not work against the strategy, vision, business imperatives, values and desired work ethic of the organisation. Management of organisations work through their human resources (HR) departments to ensure that employees are aware of what the company represents and how it operates through the company strategy, company policies, work procedures, legal and ethical obligations as well as expectations in terms of standards of work output and behaviour. HR teams have internal disciplinary programmes to ensure that misdemeanours are addressed appropriately to preserve all that the company stands for. Arguably, the more difficult human dynamic to address is the aspect of company culture that relies on an employed person for efficient work output and competency that if lacking does not result in immediate harm to the company, but may cause short, medium or long term undesirable effects. These short- and medium-term harms may be financial loss, decrease in profitability, increase in maintenance or operational costs, or decreased efficiency of systems, all of which may be very difficult to prove and account for. The long-term harm is a culture of neglect through personnel influence which goes unaddressed.

Executing energy efficiency relies heavily on the culture of the people working for an organisation [1], [2]. Without a conscious daily effort to change energy inefficient behaviour, energy efficiency at a site will not be achieved. Change management for energy efficiency is challenging compared to performing a technical task like maintaining a chiller on a specific day of the year, as it requires consistency and depends on the majority of personnel undertaking their daily activities at a site. Ensuring energy security requires a different way of thinking to the norm of simply relying on electricity from the national electricity grid. At some point, policies, standards, procedures and expectations must be put in place to ensure that the desired result is achieved. This needs to be suitably captured in the company vision, strategies and business imperatives.

Airports Company South Africa (ACSA) has the ambition to reduce carbon emissions across its airports in South Africa and put in place an energy and demand management strategy, and to this end has approved a suite of technologies to reduce carbon emissions and adopt standards and guidelines for energy efficiency. ACSA owns and operates nine airports in South Africa, namely, O R Tambo International Airport (ORTIA) (Kempton Park, Gauteng), Cape Town International Airport (CTIA) (Western Cape), King Shaka International Airport (KSIA) (Durban, KwaZulu-Natal), Port Elizabeth International Airport (PEIA) (Eastern Cape), East London Airport (Eastern Cape), Bram Fischer International Airport (BFIA) (Bloemfontein, Free State), George Airport (Eastern Cape), Upington International Airport (Northern Cape) and Kimberley Airport (Northern Cape). ACSA's energy and demand management strategy aims to make ACSA a recognised leader in the implementation of energy solutions that are economically and environmentally sustainable for airport businesses. This strategy is in line with ACSA's vision of being "... the most sought-after partner in the world for the provision of sustainable airport management solutions."

At its core, ACSA's energy and demand management strategy intend to reach carbon neutrality in electricity consumption by 2030. The three strategic objectives to support the strategy are: (1) reduce energy consumption to drive carbon neutrality, (2) introduce an energy mix that is responsive to the ACSA business and operating environment, and (3) drive an energy efficiency culture within ACSA through accountability, standardisation and a structured approach to managing energy intensive infrastructure. These strategic objectives have been translated into executable projects and initiatives that have been included in each of ACSA's nine airports' roadmaps to carbon neutrality. Significant progress has been made to reduce energy consumption and plans are in progress to realise a low carbon energy mix at the airports. The low carbon energy mix transitions the airports' current electricity demand towards carbon neutrality and makes provision for future energy demand. However, to ensure that energy wastage and practices that negate efforts to drive carbon neutrality are mitigated when new personnel join the organisation, certain standards must be adopted. To bring about a culture of energy efficiency and standardisation across existing infrastructure, adherence to green buildings requirements for all existing terminal buildings must be adopted.

Green buildings incorporate design, construction and operational practices that significantly reduce or eliminate the negative impact of development on the environment and people. Green buildings are:

- Energy efficient,
- Resource efficient,
- Environmentally responsible,
- Healthy and productive environments for people.

The Green Building Council of South Africa (GBCSA) is an independent, non-profit member-based company that was formed in 2007 to lead the greening of South Africa's commercial property sector. GBCSA provides the tools, training, knowledge, connections and networks, to promote green building practices across the country and build a national movement that aims to change the way the world is built. There are over 98 individual and recognised green building councils worldwide whose mission is to abate climate change through green building. The World Green Building Council is an umbrella organisation that provides guidance to the different green building councils, of which the GBCSA is a member alongside Australia, the United States and the United Kingdom amongst others. The GBCSA has adopted, adapted, and contextualised the Green Star rating system. Originally developed by the Green Building Council of Australia, this rating system was used as a base and has been significantly modified to fit the local market and environmental context [3].

The GBCSA started off with the Green Star Rating tools for residential, office, public and education buildings, retail developments, existing buildings, and interiors of developments. Their tools have extended to rating sustainable precincts, custom tools regarding net zero (carbon, water, waste, ecology), energy and water performance tools, and many more that meet the South African market demand. There have been over 400 green star certifications between 2007 and 2018 in South Africa [3].

Certifying existing terminal buildings will serve to hold personnel accountable to deliver a standard of energy, water and resource efficiency as well as environmental responsibility. This will also serve to independently verify the airports' achievements and recognition as leaders in environmentally sustainable solutions for airport businesses. This paper describes the green star rating frameworks of the GBCSA, and the requirements for transitioning the existing terminal buildings towards a 4-, 5- or 6-star rated terminal buildings through the implementation of certain technologies, certification according to specific standards, projects and management requirements to meet the credit requirements of the GBCSA rating frameworks.

1. GBCSA's Green Star Rated Frameworks

GBCSA has established a number of categories under which specific key criteria are grouped and assessed [4]. This framework is referred to as the Green Star SA rating framework. The basic Green Star SA structure is shown in Figure. 1.

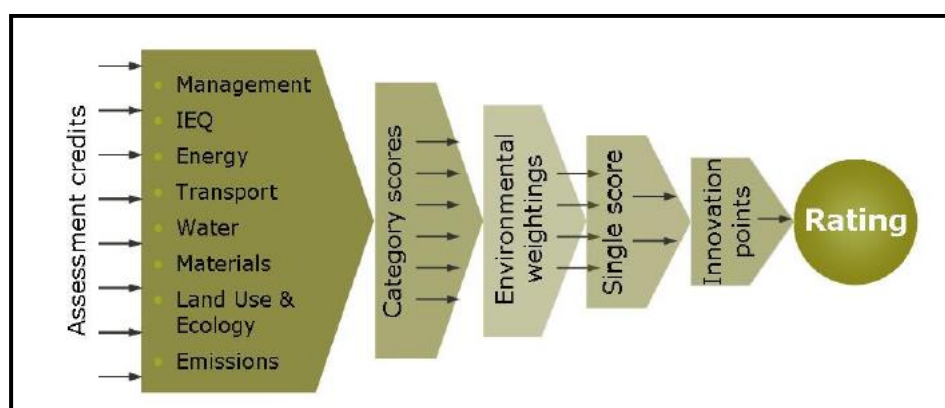


Figure 1: Structure of the Green Star SA Rating System [5].

Green Star SA rating tools include nine separate environmental impact categories:

- **Management** - promotes the adoption of environmental principles from project inception, design and construction phases, to commissioning, tuning and operation of the building and its systems.
- **Indoor Environment Quality** - targets the wellbeing of the occupants, addresses the heating and cooling systems, lighting, indoor air pollutants and building attributes that contribute to a healthier indoor environment quality.
- **Energy** - targets an overall reduction in energy consumption and a reduction of greenhouse gas (GHG) emissions associated with energy generation from fossil fuels.
- **Transport** - rewards reduction in automotive commuting by simultaneously discouraging it and encouraging the use of alternative transportation.
- **Water** - addresses the reduction of potable water use through the design of water efficient systems, rainwater collection and water reuse.
- **Materials** - targets the consumption of resources through selection and reuse of materials and efficient management practices.
- **Land Use and Ecology** - promotes initiatives to improve or reduce impacts on ecological systems and biodiversity.
- **Emissions** - targets the environmental impacts of a development's emissions or substances emitted from the site (excluding greenhouse gas emissions which are dealt with in the Energy category).
- **Innovation** - encourages, recognises and rewards the spread of innovative technologies, designs and processes for commercial building applications that impact upon environmental performance.

The categories contain credits which addresses specific initiatives that improve or have the potential to improve a design, project or building's environmental performance. Points are awarded in each credit for actions that demonstrate that the project has met the overall objectives of Green Star SA and the specific aims of the pertinent Green Star SA rating tool. Green Star SA environmental weighting factors vary across rating tools to reflect differing environmental concerns and imperatives for different building types and lifecycle phases. To encourage the development and spread of innovative technologies, designs and processes that could improve buildings' environmental performance, an 'Innovation' category is included in each Green Star SA rating tool. Table 1 [5] contains the overall score corresponding to a green star rating according to the green star rating system. [4]

Table 1: GBCSA's Green Star Rating tool Scoring and Rating

Overall Score	Rating	Represents
10-19	1-star	"On the journey to a better, greener building"
20-29	2-star	"On the journey to a better, greener building"
30-44	3-star	"Good Practice"
45-59	4-star	"Best Practice"
60-74	5-star	"South Africa Excellence"
75+	6-star	"World Leadership"

As indicated in Table 1, the minimum Green Star SA rating is 1-star and the maximum is 6-star. In the Design or As Built ratings, Green Star SA only recognises and rewards market leaders (only certifies 4-star or above), but in the Existing Building Performance tool the GBCSA recognises that the move to becoming a 4-6 star rated building may be a lengthy journey for some, and those who are doing significant work in reaching this point should be acknowledged along this journey [5].

In the process of certification (Figure. 2), the timing of the certification is very specific as are the duration of the requirements for certification which are mostly evaluated over a 12-month period. The following are the general conditions of certification which is valid for a 3-year period by which time re-certification for the next 3-year period must be achieved: [5]

- Must have been operational for a minimum of 12 months after final completion.
- The building's 'performance period' (period under which the building's performance is measured) is to be 12 consecutive months.
- Energy and Water performance periods must end within 90 days of each other.
- The project must submit for certification within 90 days of the end of the building's 12-month performance period.
- Certification is valid for 3 years from the end of the certified performance period. Thereafter re-certification will need to be undertaken.
- Re-certification can take place at any time within the 3-year period, but the project's rating will lapse if not re-certified within 3 years.
- Annual submission during the 3-year period is required for:
- Energy consumption data
- Water consumption data

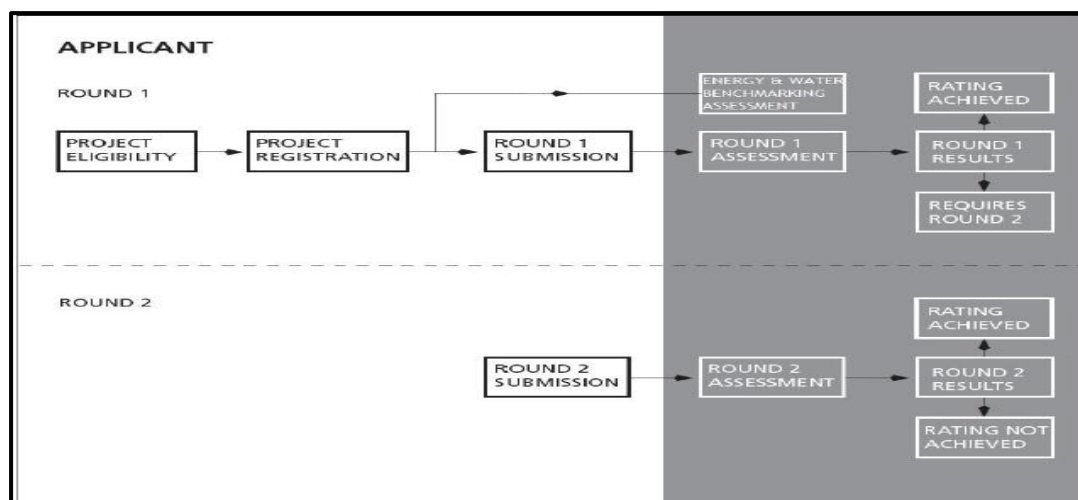


Figure 2: Overview of GBCSA Green Star Certification Process [5].

Energy and Water performance will be assessed and a formal Energy and Water Benchmarking Certificate issued to the project by the GBCSA. From submission of Energy and Water benchmarking information to the GBCSA, results will be provided within five weeks of submission. From the date of receipt of the project's submission of all targeted credits (Round 1), the GBCSA provides the assessment results within seven weeks. Upon receipt of these results, the project may be required to submit documentation for credits to be confirmed. The project will then be required to provide the Round 2 submission within 90 days of the Round 1 assessment results being issued [5]. The following sections contain the structure of the technical manuals drafted for existing airport terminal buildings to transition towards a green star rating (4- to 6-star).

2. Requirements to Transition Existing Terminal Buildings Towards a Green Star Rating

The targeting of certain credits is based on what is key to ACSA's business focus as well as convenience and strategic intention for their existing terminal buildings to achieve 4-, 5- and 6-star ratings, and further converts the expectations in these credits into three categories for execution:

- **Standards Compliance (SC):** This section lists the standards that the terminal building specific systems must comply with in order to achieve the targeted green star rating.
- **Project Requirements (PR):** This section has all project requirements that must be initiated so that GBCSA requirements are met to achieve the targeted green star rating.
- **Management Practices (MP):** These are everyday operational management practices that must be put in place to meet GBCSA's requirements for the targeted green star rating.

The information given in all the sections above are designed to be cumulative, i.e., to achieve a 5-star green rating, the 4-star green rating requirements must be achieved and additional requirements listed under the 5-star green rating must be implemented, etc.

3. Rationale for the Selection of Credits to Make up the Green Star Ratings for the New Airport Infrastructure

The following sections present the business imperatives that played a role in the selection of the credits to be targeted for the 4-star, 5-star and 6-star rated green buildings. The rationale used when targeting the number of credits with the range given for a 4-star, 5-star and 6-star rating is provided and the credits that are most targeted as well as those less targeted due to lack of focus of the business in those areas are listed.

3.1 Business Imperatives

One of the most important steps in targeting a green star rating is the selection of the combination of credits that gives points for meeting the requirements for the green star rating being applied for (Table 1). The selection of credits has financial implications but with careful planning, the overall costs can be negligible and such investments can actually reduce operational and maintenance costs making for an attractive business case. The credits to be targeted in each of the green star frameworks (4-, 5- and 6-star green ratings) have been chosen on the following ACSA business principles: [3]

- Savings in operational cost with preferably low or no extra capital cost, and any extra capital costs to be offset within the project, e.g., extra capital cost for using passive cooling techniques such as low emissivity glass and insulation will result in a lower cooling and heating load and thus a smaller capacity HVAC system, lower capex

cost of HVAC, lower electricity cost for operations and potentially lower maintenance cost for a smaller system.

- Supporting of the organisational strategic goals, especially those that are aligned to ACSA's vision for stand-alone airports, reduction in operational cost (running and maintenance costs), Occupational Health and Safety and Asset Information Management imperatives.
- Focus placed on credits that reduce environmental impact and thus significant weighting of water, waste and energy consumption.
- Knowledge transfer and operating conditions that are fine tuned for operational efficiency.
- Focus on credits that support the Airports Council International (ACI) Carbon Accreditation system [3].

3.2 Green Building Framework Design

The combination of credits targeted by ACSA have been designed to always give points over the minimum threshold for the targeted green star rating due to the nature of project execution in general, bearing in mind that thoroughness in terms of project documentation, timelines in terms of project duration and loss in communication in design and execution, result in certain credits targeted not being able to be awarded as per GBCSA strict rules. For this reason, the green star rating target is designed to aim for at least four points above the threshold for the targeted green star rating but not within five points or less than the threshold for the next green star rating, as this would mean extra cost and effort for the same green star rating.

3.3 Green Building Credits Targeted and Excluded

In following with the business case for green buildings and in keeping with the ACSA operating environment and business imperatives, the credits categories are targeted as follows:

- Water and Energy – credits within these categories have been maximised as they are both high in operational cost and scarce resources in South Africa.
- Waste management – credits within the Materials category have also been targeted towards social responsibility and looming legislation of reduced waste to landfill by 2025 (Western Cape) with penalties for non-compliance and is the direction that most of the world is heading in.
- Credits throughout the categories that embed ease of maintenance, operations and management of infrastructure, health and safety best practices, project management, and construction management, are maximised for a good foundation which can facilitate ACSA's vision and its strategic objectives.
- Credits that allow for implementation considering the highly regulated environment that ACSA complies with and considering the known market capabilities (local and international, i.e., the South African marketplace and environmental context).

The following credits have been intentionally limited due to their lack of support of the business and operating environment of ACSA:

- Credits involving transport have been excluded as these are typically not considered per building, but rather as an airport planning exercise and in response to demand and commercial opportunity.

- Innovative strategy credits have been excluded to divorce dependency on them to make up the credits needed for the targeted green star rating, as these innovation points are awarded solely on the discretion of Green Buildings Council South Africa.

4. Standards for Compliance, Project Requirements and Management Practices for Airports' Existing Terminal Buildings Green Star Ratings

The Technical Manual Existing Building Performance Tool V1, December 2014 by the GBCSA, provides criteria to be met for each of the nine categories described, however, the manual does not always give the interventions to be adopted that would enable a project to meet the criteria. The following tables (Table 2, Table 3, and Table 4) provide the preferential selection of credits by describing the standards for compliance, project requirements and management practice requirements to be met for each green star rating.

Table 2: Requirements for Airport Green Star Rated Existing Terminal Buildings: Standards for Compliance

4-star rating standards for compliance	<ul style="list-style-type: none"> • Audit, monitor and measure lighting levels of at least 60 % of the occupied areas to comply with maximum maintained illuminance level of no more than 80 % of the levels prescribed in SANS 10114-1:2005. These requirements must be captured for tenants in lease agreements, obtaining their signed commitment. This must be put in place before the 12-month trial period begins. • Put in place a process to manage overall risk presented by Legionnaires' disease during the 12-month trial period. Furthermore, it should be demonstrated that such a risk management process is monitored and reviewed regularly as per SANS 893 Part 1. Put in place an effective programme for treatment and control of Legionnaires' disease in water systems during the 12-month trial period as per SANS 893 Part 2.
5-star rating standards for compliance	<ul style="list-style-type: none"> • Perform quantitative acoustic testing through an acoustic specialist to ensure that internal noise levels are within 2 dBA of the maximum equivalent continuous rating levels as set out in SANS 10103:2008, with less than 10 % of areas non-compliant. Confirmation that noise from building services plant does not exceed the recommended levels of noise as set out in SANS 10103:2008 at the property boundary, or does not exceed the existing baseline ambient noise level (8h LAeq) by 3 dBC at the property boundary, or demonstrates compliance with provincial noise control regulations where applicable. This must be ready for evaluation at any time within the 12-month trial period.
6-star rating standards for compliance	None for the selected credits for 6-star rated existing terminal buildings

Table 3: Requirements for Airport Green Star Rated Existing Terminal Buildings: Project Requirements

- Appoint a green star accredited professional to consult with and guide the preparation and accreditation process at least 6 months before the trial period and for 5-6 months after the trial period for the preparation of response to the Round 1 submissions.
- Building management system (BMS) to include automated water and electricity monitoring and reporting.
- Put in place an advanced monitoring and metering strategy that covers relevant areas or functions of a building, collecting and processing data, alerting management in case of missing data and when consumption is out of targeted parameters, and producing quarterly reports. This must be put in place before the 12-month trial period begins.
- Put in place physical displays containing real-time information of energy and water performance of the building as well as communication on sustainability features and initiatives. Put in place awareness programmes that include energy efficiency, water efficiency, waste management as a minimum, for all building occupants. This must be put in place and be tested in the 12-month trial period.
- Appoint an indoor air quality (IAQ) manager to supervise and manage the optimisation of practices that prevent and minimise the build-up of indoor pollutants in buildings. System performance audit to be performed to ensure specific air quality criteria are being met, with corrective action plan in place. IAQ testing to maintain CO levels not exceeding 26 ppm and CO₂ levels not exceeding 1000 ppm for at least 70 % of the measured areas. This will be measured for the duration of the 12-month trial period.
- Luminaire magnetic ballasts to be changed to high-frequency electronic ballasts, magnetic ballast replacement policy in place, audit performed to confirm that 95 % of lighting is high frequency. These requirements must be captured for tenants in lease agreements, obtaining their signed commitment. This must be put place before the 12-month trial period begins.
- Occupant survey for thermal comfort and temperature to be measured in occupied spaces at least once in the summer and once in the winter with corrective action plan in place to correct any concerns. For areas that are tenanted, include these requirements in lease agreements. This must be preferably in place and ready to be checked anytime within the 12-month trial period.
- Perform an occupant comfort survey that covers acoustic comfort, thermal comfort, lighting comfort, indoor air quality and ventilation comfort, and building management cleanliness (odours, etc.) requiring more than 80 % of respondents to be satisfied, with a corrective action plan in place to improve performance. This must be ready to be evaluated at any time within the 12-month trial period.
- Perform a high-level acoustic audit considering occupant feedback, impact of plant and equipment noise on occupants, surrounding properties and external noise on occupants including noise transference between tenancies, putting in place a corrective action plan to improve performance. Issue operational guidelines to tenants with recommendations with regards to fit-out for acoustic comfort and space utilization for acoustic comfort. This must be ready to be evaluated at any time within the 12-month trial period.

5-star rating project requirements	<ul style="list-style-type: none"> • Energy saving projects to be activated and put in place before the 12-month trial period begins, to reduce kWh consumption onsite: <ul style="list-style-type: none"> • Execution of lighting replacement programme to ensure that the existing installations are transformed to LED lighting • Execution of lighting control programmes to ensure that lighting is controlled according to demand • Implementation of HVAC time schedules and chiller loading methodology to ensure that energy consumption is optimised • For coastal airports, employment of heat pipe dehumidification in fresh air units • Adoption of air-economising (free air cooling) in existing HVAC systems • Incorporation of active chilled water setpoint control for chillers • Installation of ducted return air with feedback control sensors for temperature control • Adoption of constant air volume (CAV) to cool the baseload and variable air volume (VAV) for fluctuating load • Incorporate heat recovery from the condenser to satisfy any heating requirements • Reduction in cooling demand using low emissivity glass (not more than 3 W/m²K) and heat deflective paint (adopting ceramic microspheres) to deflect solar heat gain <p>IAQ testing showing CO₂ levels not exceeding 800 ppm for at least 70 % of the measured areas. This will be measured for the duration of the 12-month trial period.</p> <ul style="list-style-type: none"> • Implement frameworks and programmes to encourage and incentivise (or create a shared incentive) for the top ten energy users to reduce onsite energy consumption and maximum demand. • Additionally, implement the following before the beginning of the 12-month trial period for further potable water savings: <ul style="list-style-type: none"> • Water reuse for washing of motor vehicles. • Flushing of toilets with grey water/reused water. • 100 % of the refrigerants by mass serving the building has to have ODP and at least 50 % to have a GWP (global warming potential) of less than 10.
6-star rating project requirements	<ul style="list-style-type: none"> • Implement a project to adopt solar thermal absorption cooling or make use of waste heat to power absorption chillers. • Additionally, implement the following before the 12-month trial period begins for further water savings: <ul style="list-style-type: none"> • Borehole water use for non-potable water demand. • Where potable water is supplied to an end-use such as a toilet or basin, solenoid control valves for automatic shut off must be installed. Water supply to the toilet area/amenity (as per the internal water zoning) must be controlled according to occupancy through a sensor and or timer.

Table 4: Requirements for Airport Green Star Rated Terminal Buildings: Management Practice Requirements

<p>4-star rating management practice requirements</p>	<ul style="list-style-type: none"> • Compile and implement a building operations manual as a guide for operating building systems efficiently and managing resources effectively to be done before the 12-month trial period begins. • Issue a building user's guide issued to users, occupants and tenants that includes the energy and environmental strategy, the monitoring and targets for water and energy consumption, operation of the air conditioning, lighting, electrical and hot water systems, details on transport facilities, materials and waste recycling, community facilities, landscape management and biodiversity features, as well as preferred materials for refurbishing and fitting out a rented space. This must be in place before the 12-month trial period begins. • Compile and implement a maintenance schedule in relation to operational expenditure items only to contain (at least) planned preventative types of maintenance activities for electrical and electronic systems, mechanical systems and fire protection systems. This must be put in place before the 12-month trial period begins. • Put in place a building tuning process that includes an initial audit of the existing system, followed by reporting and an action plan leading to continuous monitoring, system testing, corrective action response, ongoing measurement and appropriate documentation for BMS systems and air conditioning systems. This must be put in place before the 12-month trial period begins. • Issue and implement a green cleaning policy in line with specific sustainability criteria. This should preferably be put in place before the 12-month trial period begins, it is however measured over a 6-month period. • Implement a green lease for new leases and lease renewals that will include cost and benefit sharing mechanisms, specific requirements for tenancy fit out and alterations, management and operations, owner commitment covering at least 20 % of the total tenanted gross lettable area. This should be put in place before the 12-month trial period begins. • Put in place a landscape management plan according to leading practice methods, hard surface and building exterior management plan according to leading practice methods, and an integrated pest management plan. This will be evaluated anytime within the 12-month performance period. • Implement a storm water run-off management plan which ensures that the site and hard surfaces are managed to control storm water runoff and filter litter or pollutants to reduce peak flows, erosion and contamination of ground water, streams and rivers. Include an annual inspection programme of all storm water facilities to confirm continued performance. Peak storm water flows must be calculated and disclosed for the performance period and required maintenance that was assessed must be implemented. This must be ready to be evaluated anytime within the 12-month trial period.
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5-star rating management practice requirements	<ul style="list-style-type: none"> • Purchase green cleaning consumables in line with specific sustainability criteria. This should preferably be put in place before the 12-month trial period begins, it is however measured over a 6-month period. • Implement a green lease for new leases and lease renewals that include cost and benefit sharing mechanisms, specific requirements for tenancy fit out and alterations, management and operations, owner commitment covering a total of at least 50% of the total tenanted gross lettable area. This should be put in place before the 12-month trial period begins. • Put in place a specific green procurement policy aligned with the Green Star SA Policy & Programme Model which encourages use of products that are environmentally preferable that will be evaluated within the 12-month trial period. • Put in place a solid waste management policy whose scope includes ongoing consumables, hazardous materials, movable and electronic goods and construction waste from churn and alterations. Execute a waste stream audit; carry out a waste stream audit of the building's entire ongoing consumable waste stream to establish a baseline that identifies the types and amounts of waste making up the waste stream, thereby identifying opportunities for increased waste minimisation, recycling and waste diversion from which an operational waste and materials management plan (OWMMP) must be put in place. Diversion of 75 % of operational waste to landfill, 50 % of construction waste diverted, and hazardous waste being collected in a separate process. Reduce generation of operational waste by 10 %. The policy will be evaluated anytime within the 12-month trial period, whereas the rest of the requirements must be actively executed within the 12-month trial period.
6-star rating management practice requirements	<ul style="list-style-type: none"> • Perform a cleaning audit in line with GBCSA's requirements. This should preferably be put in place before the 12-month trial period begins, it is however measured over a 6-month period. • Provides at least one 'Community Facility' for access and benefit to the local community or public and a shared facility within the building that is actively utilised to allow part-time use for community or public benefit activities. This must be put in place before the 12-month trial period begins.

The requirements contained in Table 2, Table 3 and Table 4 are highly summarised and correspond to credits that amount to the number of points for a 4-star, 5-star and 6-star green rating.

4. Process to Implement Green Buildings for Existing Airport Terminal Buildings

It is advisable to run the implementation of a green star rating for existing terminal buildings as a project every two years to maintain the 3-year renewable cycle of the green star rating certification. Figure. 3 sets out the steps required for the first certification of a green star rating of an existing terminal building.



Figure 3: Proposed Process to Transition Existing Terminal Buildings to Green Star Certification by GBCSA.

It is critical to gain top management support and funding and it will be most beneficial to gain the support of all stakeholders, and to establish networks and working groups that include stakeholders both inside and outside the organisation as support and coordination is paramount for the accomplishment of successful green star certification.

CONCLUSIONS

This paper presented the guidelines for transitioning existing terminal buildings towards and 4-, 5- and 6-star green rating. The guidelines included standards for compliance, project requirements and management practice requirements for a 4-star, 5-star and 6-star green rated terminal building. A description of the green star rating frameworks and the rationale used to select the credits that give the green star rating is given. The process to transition the green star rated infrastructure at the airports is outlined so as to reduce carbon emission and cultivate environmental consciousness. This will ensure that the efforts to transform the airport sites towards energy efficiency and energy security are sustained.

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